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The Impact of China's Location Based Environmental Regulations on Hog Industry and Water Quality: A Synthetic Difference in differences Approach

Nieyan Cheng
Iowa State University, nycheng@iastate.edu

Wendong Zhang
Iowa State University, wdzhang@iastate.edu

Tao Xiong
Huazhong Agricultural University

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Nieyan Cheng
Department of Economics
Iowa State University
nycheng@iastate.edu

Wendong Zhang
Department of Economics
Iowa State University
wdzhang@iastate.edu

Tao Xiong
Department of Agricultural Economics & Management
Huazhong Agricultural University
taoxiong@mail.hzau.edu.cn

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Nieyan Cheng[1,2], Wendong Zhang[1,2], Tao Xiong[3]

Introduction

- Water pollution from livestock manure becomes a global issue.
- China set up location-based environmental regulations since 2014 to regulate hog manure. The whole country has been divided into Development Control Zones (DCZs) and Non-development Control Zones (Non-DCZs).
- Closure is the main implementation method for provinces in DCZs.

Research Questions

- Can China's location-based environmental regulations on the livestock industry significantly reduce hog inventory and improve water quality?
- Are the changes of hog inventory and water quality different across provinces and within province?

Empirical Strategy: Synthetic DID

- Division of DCZs and Non-DCZs.
- Before and after regulation implementation.

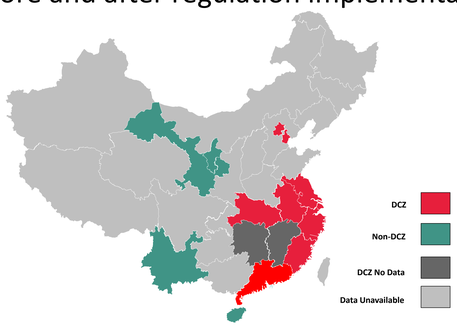

Figure 1: Map of Environmental Control Zones in China

The 2014-2015 Chinese location-based environmental regulations led to 14.7% reduction in hog inventory in DCZ provinces 2016-2017.

- ✓ Heterogeneous treatment effects across and within provinces
  - 28.6 % decline in Zhejiang vs. no reduction in Guangdong, Fujian and Anhui
  - Major hog counties have larger ATT

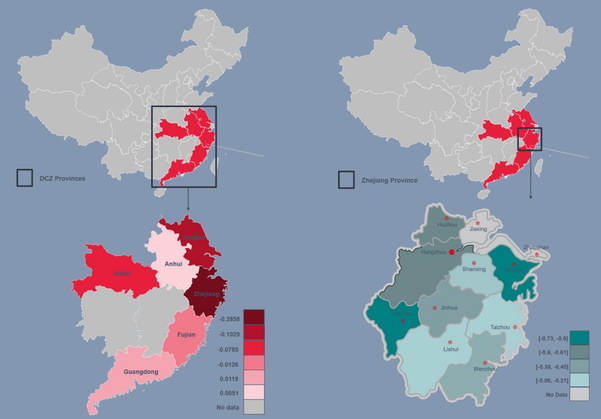

Figure 5: Results of DCZs and Zhejiang Province For Hog Inventory

No evidence of achieving intended policy goal of improving downstream water quality.

Advantages of Synthetic DID over traditional DID and synthetic controls

- Relax parallel common trend assumption
- Adjust imperfect pre-trend fit of synthetic control method

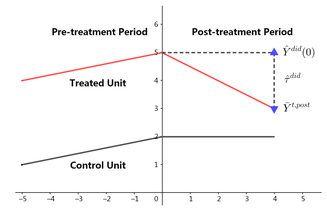

Figure 2: Difference-in-differences Method

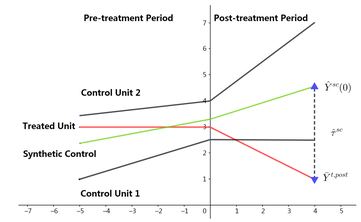

Figure 3: Synthetic Control Method

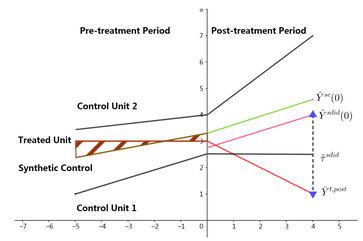

Figure 4: Synthetic Difference-in-differences Method

Data: County level hog inventory data from provincial statistical yearbooks 2010-2017

Selected Reference:

- Arkhangelsky, D., Athey, S., Hirshberg, D. A., Imbens, G. W., & Wager, S. (2019). Synthetic difference in differences (No. w25532). National Bureau of Economic Research.
- R package: https://github.com/davidahirshberg/synthdid

1 Iowa State University Department of Economics 2 CARD Center for Agricultural and Rural Development 3